Space Weather Technical Forecast

Issued on Friday, 19 April 2024 at 13:22 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Further M-flares likely and a slight chance of X-flares. G1/Minor Storm period due to arrival of CME day 1 (19 Apr), gradually waning. Slight chance of G1/Minor Storm interval on day 2 (20 Apr) due to coronal hole high speed stream. Further slight chance of G1/Minor Storms end of period due to possible glancing CMEs.

Solar Activity: Activity is currently Moderate, with largest flare an M2.1 event, which peaked at 19/0453 UTC from AR3647 in the southeast. Background flux remains at C-class levels. There are currently fourteen sunspot regions on the visible disc. AR3639 and AR3645 are the largest regions. AR3647 is close to AR3645, and contains a delta spot. AR3645 has decreased slightly in area, but continues to have movement of the spots within the region, making it unstable. AR3643, AR3645, AR3647 all appear to be magnetically connected, enhancing complexity and susceptibility to significant flaring. The remaining numbered regions appear generally stable. Newly numbered AR3650 in the southeast has shown the greatest development, although this now appears to be stable. AR3634 has now rotated onto the west limb and is no longer visible.
Several CMEs have been observed from an area near AR3638 over the past 24 hours. Most of these CME's have been analysed, with weak glancing blows possible on 21 or 22 Apr. However, confidence is low regarding this. No other Earth-directed CMEs have been observed.

Solar Wind / Geomagnetic Activity: Solar wind parameters started the period at background levels, before increasing to slightly elevated levels, just above 400km/s, due to the late arrival of a CME which left the Sun on the 15 Apr and arrived at L1/DSCOVR at 19/0411 UTC. Density was below average initially, before increasing to above average levels, peaking at 30ppcc at 19/0758 UTC, following the arrival of the CME. The Interplanetary magnetic field (IMF) strength, Bt, was initially weak, before increasing and currently peaking at 16nT, due to CME arrival. The north-south component, Bz, was mostly positive at the start of the period, before significantly declining into the negative due to the CME, reaching -13nT at 19/0742 UTC. Phi angle was mostly negative (towards the Sun) with some variability into the positive after 19/0000 UTC. Resultant geomagnetic activity was mostly Quiet (Kp0-2) initially, before increasing to reach G1/Minor Storm (Kp5) interval 19/0600-0900 UTC.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) observed at GOES-18 was at background. High energy electron flux (greater than 2MeV) observed at GOES-16 was predominantly at background levels, occasionally reaching moderate levels. The associated 24-hour fluence remained below Active (1e8 integrated flux) with a value of 1.3e6 integrated pfu observed at 19/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate activity is forecast with isolated M-class flares expected and a slight chance of isolated X-class flares.

Solar Wind / Geomagnetic Activity: A CME, which left the Sun on the 15 Apr, looks to have arrived early day 1 (19 Apr), with geomagnetic activity reaching G1/Minor Storm level, although

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these effects should quickly wane. Further CMEs associated with streams of plasma originating from AR3638 in the southeast may give some weak transient features during days 3 and 4 (21st and 22nd), although confidence is low regarding this. Solar winds are currently at slightly elevated due to the recent arrival of a CME, near 400km/s, but a recurrent coronal hole high-speed stream is expected to become geoeffective on day 2 (20 Apr) likely increasing speeds to elevated levels, continuing into day 3 (21 Apr), before gradually waning by day 4 (22 Apr).
Geomagnetic activity has started the period at G1/Minor Storm levels due to the arrival of a CME, but should gradually reduce to Active or Unsettled (Kp3-4) conditions, becoming mostly Quiet (Kp1-2) by the end of day 1 (19 Apr). Activity may increase to occasionally reach Active to G1/Minor Storm (Kp 4-5) levels tomorrow (20 Apr) due to the arrival of a HSS from CH25/-, and also possibly at times during days 3 and 4 (21st and 22nd) due to a slight chance of glancing blows from CMEs.

Energetic Particles / Solar Radiation: High energy proton flux as observed by GOES-18 is forecasted to persist at background. High energy electron flux as observed by GOES-16 is expected to remain at background to moderate levels. The associated 24hr electron fluence is expected to remain below the Active (1e8 integrated pfu) threshold.

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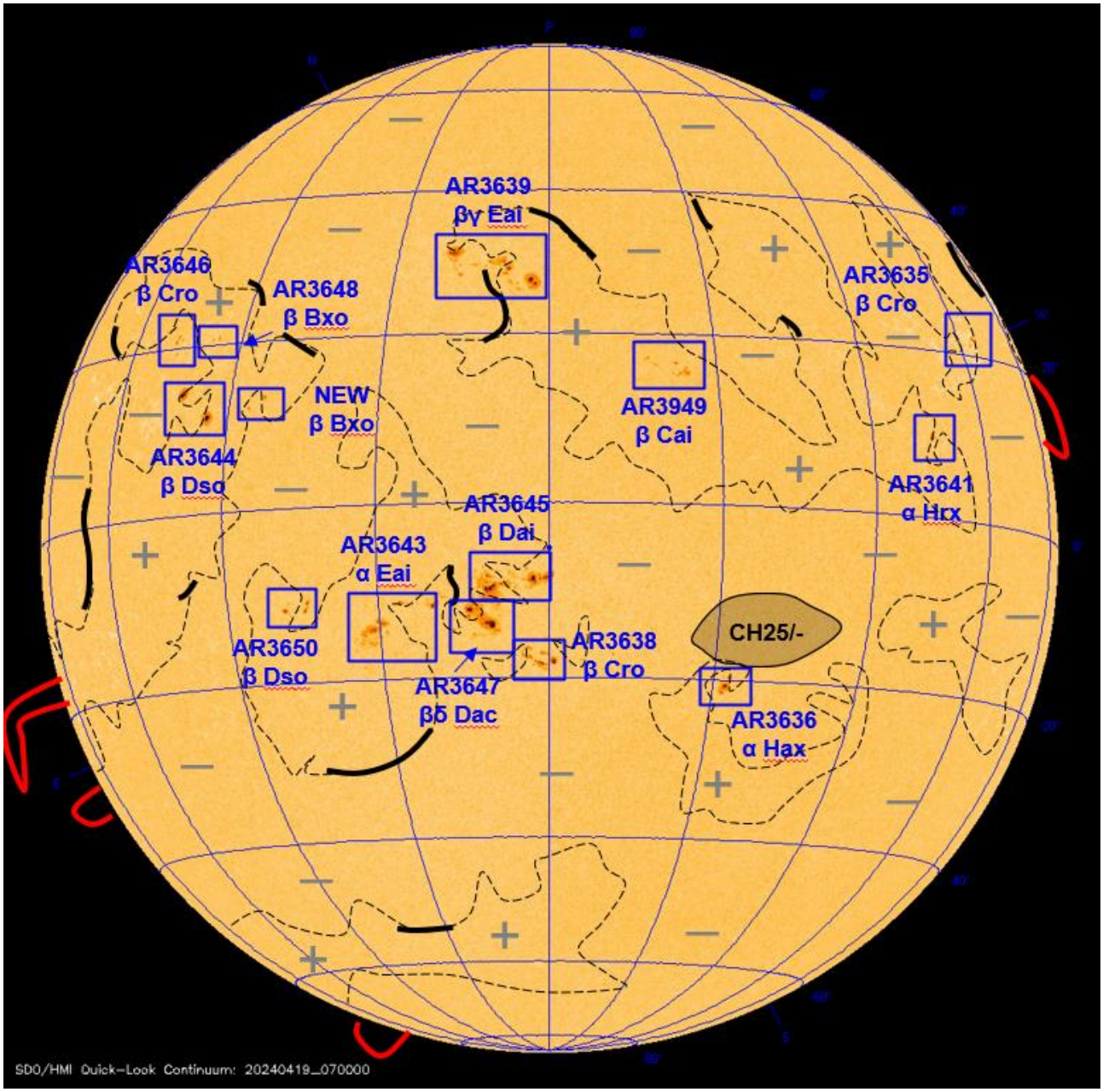
Figure 1. Solar Analysis Valid 19/0700 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A CME that left the Sun following a flare and subsequent filament eruption, from the southeast disc near AR3636 on 15 Apr, looks to have arrived early on day 1 (19 Apr), which has increased geomagnetic activity reaching G1/Minor Storm (Kp5) 19/0600-0900 UTC. The effects of the CME should begin to wane through the remainder of day 1.

Coronal hole 25 is expected to become geo-effective later tomorrow (20 Apr). This is a persistent feature and gave peak speeds of around 550km/s on the previous rotation. The coronal hole itself appears smaller than on the previous rotation, though its equivalent position on the disc remains similar, so persistence forecasting for the onset carries moderately-high confidence, though likely with lower peak speeds than seen in March, estimated to be around 450-500km/s. This feature is not adequately modelled by Enlil presently.

Several CMEs have been observed from an area near AR3638 over the previous 24 hours. Most of these of the CME's have been analysed, with weak glancing blows possible on 21 or 22 Apr. However, confidence is low regarding this.

Geomagnetic activity has started the period at G1/Minor Storm levels due to the arrival of a CME, but should gradually reduce to Active or Unsettled (Kp3-4) conditions, becoming mostly Quiet (Kp1-2) by the end of day 1 (19 Apr). Activity may increase to occasionally reach Active to G1/Minor Storm (Kp 4-5) levels tomorrow (20 Apr) due to the arrival of a HSS from CH25/-, and also possibly at times during days 3 and 4 (21st and 22nd) due to a slight chance of glancing blows from CMEs.

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	Yes	50	30	20	20
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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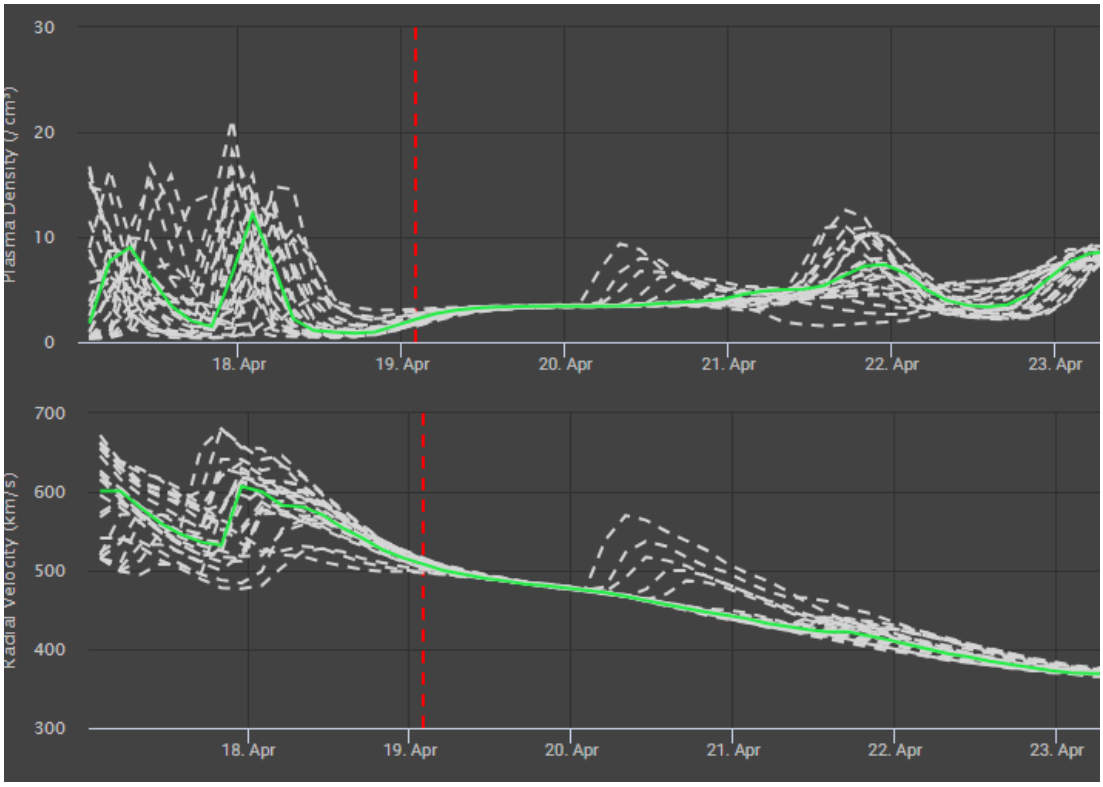
Figure 2: MOSWOC Enlil ensembles shows possible weak glancing CMEs during the 21/22 April.



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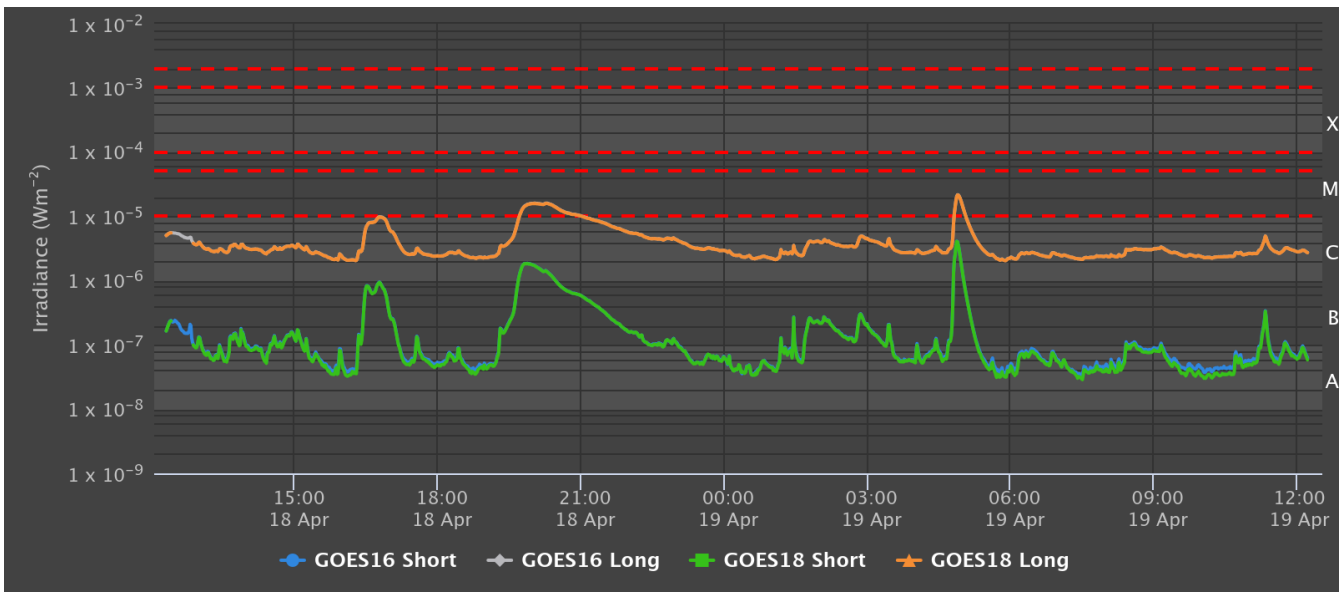
Radio Blackouts - X-Ray Flares:

There are currently fourteen sunspot regions on the visible disc. AR3639 and AR3645 are the largest regions. AR3647 is close to AR3645, and has a delta spot. AR3645 has decreased slightly in area, but continues to have movement of the spots within the region, making it unstable. AR3643, AR3645, AR3647 all appear to be magnetically connected, enhancing complexity and susceptibility to significant flaring. The remaining numbered regions appear generally stable with only slight changes since the previous analysis. Three new, small, weak and magnetically simple, regions have recently developed, with the region in the southeast, close to AR3643, showing the greatest development. AR3634 has now rotated onto the west limb and is no longer visible.

Moderate activity is forecast with isolated M-class flares expected and a slight chance of isolated X-class flares. AR3639 and the combination of AR3643, AR3645 and AR3647 are the most likely to produce significant flares. As all of these regions are currently in the eastern hemisphere, and not close to rotating off the visible disc, so the forecast probabilities remain constant throughout. Also, no new significant regions are expected to rotate onto the visible disc.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	75	75	75	75
Very Active	R3 to R5 X Class	No	15	15	15	15

Figure 3: GOES X-Ray Flux trace



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Solar Radiation Storms - (High Energy Protons):
High energy proton flux as observed by GOES-18 has persisted at background levels and is expected to generally remain so. There is a slight chance of the observed flux increasing in response to any notable flares. This is initially due to AR3634, which has now rotated off the western limb. The regions that are most likely to produce proton rich flares will gradually rotate west, reaching more favourable positions for proton rich flares to be observed at GEO, especially towards the end of the period.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	10	10	15
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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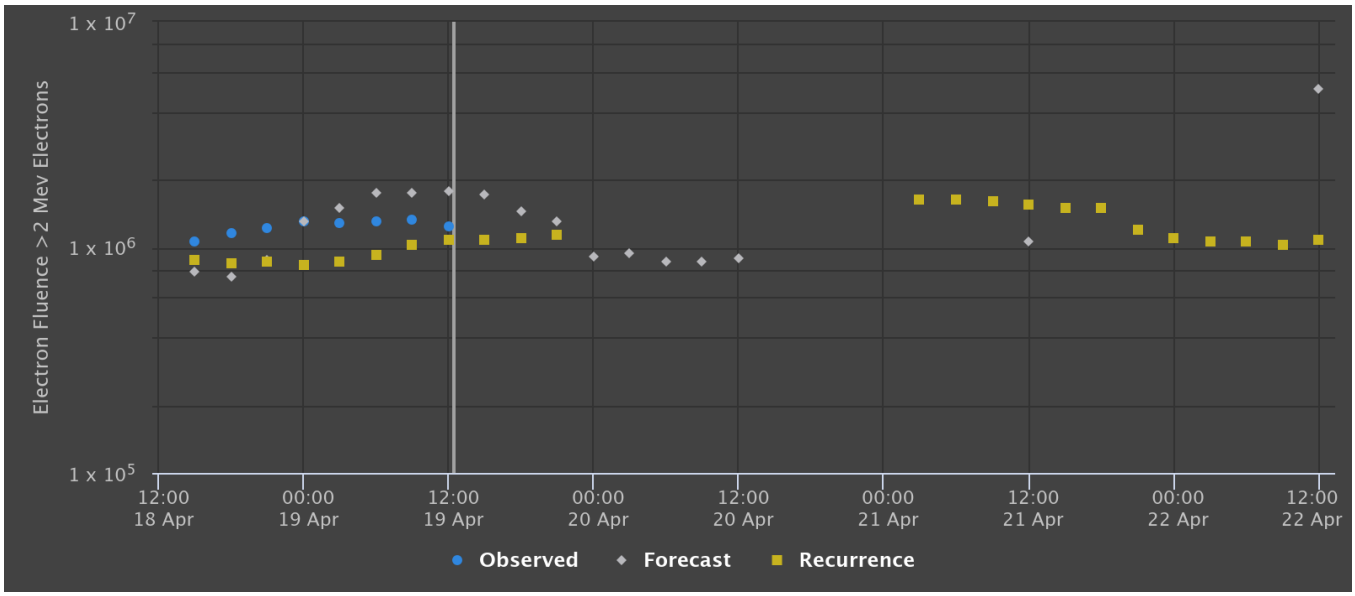
High Energy Electrons Event (≥ 2MeV):
High energy electron flux as observed by GOES-16 is expected to remain at background to moderate levels with occasionally slightly enhanced geomagnetic activity expected to generally suppress values in the coming days.

The associated 24hr electron fluence is expected to remain well below the Active (1e8 integrated pfu) threshold, with current REFM output accepted as good guidance.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: MOSWOC REFM electron fluence



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